MASTER OF SCIENCE
IN
SPACE SYSTEMS OPERATIONS

QUANTIFYING THE EFFECT OF CRYPTOLOGY AS A DECISION MAKING TOOL FOR THE NAVAL WARFIGHTER

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HIGH ALTITUDE LONG ENDURANCE (HALE) PLATFORMS FOR TACTICAL WIRELESS COMMUNICATIONS AND SENSOR USE IN MILITARY OPERATIONS

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United States military forces are transitioning to network centric operations, as described in Joint Vision 2010 and Joint Vision 2020. Warfighting elements will function as individual nodes in a global information grid with an end-to-end infrastructure that provides information on demand to warfighters, policymakers, and support personnel. This transition will place additional demands on wireless communications and Intelligence, Surveillance, and Reconnaissance (ISR) systems. However, current and planned space-based communications solutions are costly and have significant shortfalls. Likewise, ISR systems will have difficulty fulfilling near real-time requirements and sensor-to-shooter roles. One possible solution is through the use of emerging stratospheric platforms. In the area of communications and ISR support, this thesis; reviews the Services' doctrines and future warfighting needs, identifies available space-based systems along with their shortfalls, and defines support capabilities from the stratospheric environment. It then provides an in-depth review of emerging high altitude long endurance (HALE) platforms, analyzes HALE platforms survivability, provides a concept of operations (CONOPS) for HALE employment, and performs a HALE platform comparative analysis.

PROJECT OVERVIEW OF THE NAVAL POSTGRADUATE SCHOOL SPACECRAFT ARCHITECTURE AND TECHNOLOGY DEMONSTRATION EXPERIMENT

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The Naval Postgraduate School's current attempt at getting another spacecraft into orbit is focusing on Naval Postgraduate School Spacecraft Architecture and Technology Demonstration Experiment (NPSAT1). Building on lessons learned from PANSAT, in addition to targeting incremental improvements and advances in multiple areas of spacecraft design, NPSAT1 is being built as a three-axis stabilized platform. It will be using commercial-off-the-shelf (COTS) components in many of its subsystems to provide some testing and experimentation on how certain COTS components can handle space environments and the challenges this unique environment presents. Other characteristics of NPSAT1 include a PC-compatible Command and Data Handling (C&DH) subsystem, lithium-ion polymer batteries, a Linux operating system, and Ferroelectric RAM.

NPS possesses a unique ability to educate a large number of service personnel in a wide variety of space-related topics. In particular, NPS is not only able to provide classroom and laboratory education on principles, concepts, philosophies, and historical perspectives of space, but also it can provide the student the opportunity to conduct on-orbit operations and testing of the same spacecraft that were designed and built on the grounds of the NPS campus. This thesis describes the overall NPSAT1 design project, including descriptions of the five experiments onboard, and many of the associated requirements that ultimately lead to a successful mission on orbit.

MODELING THE EFFECTS OF GPS JAMMING ON A THEATER CAMPAIGN

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This study reviews the manner in which four precision-guided weapons utilize the NAVSTAR Global Positioning System (GPS) to increase their accuracy, and threats to GPS that may be employed to reduce their accuracy. The study incorporates a Navy-approved Modeling and Simulation (M&S) program to modify weapons parameters affected by GPS. The M&S system is used to simulate a large-scale theater campaign, based upon actual war plans. The results of the simulation scenario are used to evaluate possible threats to GPS guided weapons and to highlight thought processes that military planners may need to consider when operating in a GPS-denied or GPS-degraded electronic warfare environment.

SPACE TRAINING AND EDUCATION FOR USN CRYPTOLOGIC OFFICERS – THE ROAD TO SPACE CERTIFICATION

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This thesis discusses the importance of space-related education and training for Naval cryptologic officers in their efforts to support the warfighter. It includes a discussion of the learning continuum concept, an outline of cryptologic officer's career milestones for space-related training, and a discussion of the Navy's Distributed Learning initiatives. This thesis provides a framework for the establishment of a Space

Certification Program for Naval cryptologists. The proposed Space Certification model was designed to allow expansion of the program to include Naval officers in other communities.

EVALUATION OF SURVEILLANCE RECONNAISSANCE MANAGEMENT TOOL AND UTILITY/FUNCTIONALITY TO FUTURE SURFACE COMBATANTS

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ANALYSIS OF A MAGNETIC THREE-AXIS STABILIZED ATTITUDE CONTROL SYSTEM FOR THE NPSAT1 SPACECRAFT

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The NPSAT1 satellite uses an active magnetic torque rod system, with a magnetometer for attitude determination, to maintain 3-axis stabilization, with a slightly gravity gradient friendly structure.

This thesis will examine the performance of three combinations of programs and simulation models for the NPSAT1 satellite attitude control system. The models include a magnetic control law with a reduced order estimator to generate torque commands to achieve spacecraft nadir pointing and a magnetic rate (Bdot) control law to reduce spacecraft angular rates. The performances of two Bdot mode switching designs are compared. Also, a case is made for the benefits of priming the system's reduced estimator prior to mode switching.

All of the control methods analyzed appear to be valid control methods to achieve three-axis attitude stabilization using only magnetic torquers for active control. The most efficient control method analyzed incorporates a hand-off method from a magnetic rate (Bdot) control loop to a magnetic control loop. The results of this analysis indicates that the best use of this method is to perform the Bdot hand-off following the achievement of a predetermined combined angular rate.